



## Support schemes and risk premiums for renewable energy technologies

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## Support Schemes and Risk Premiums for Renewable Energy Technologies

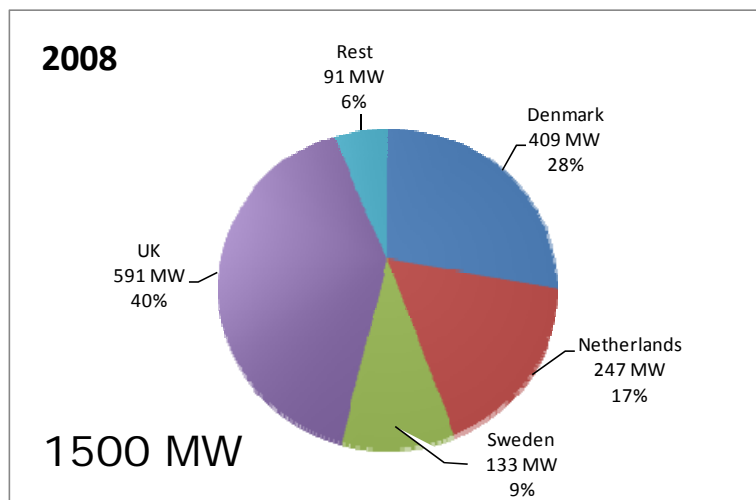
Poul Erik Morthorst, Risø DTU

Stine Grenaa Jensen, Danish Energy Association

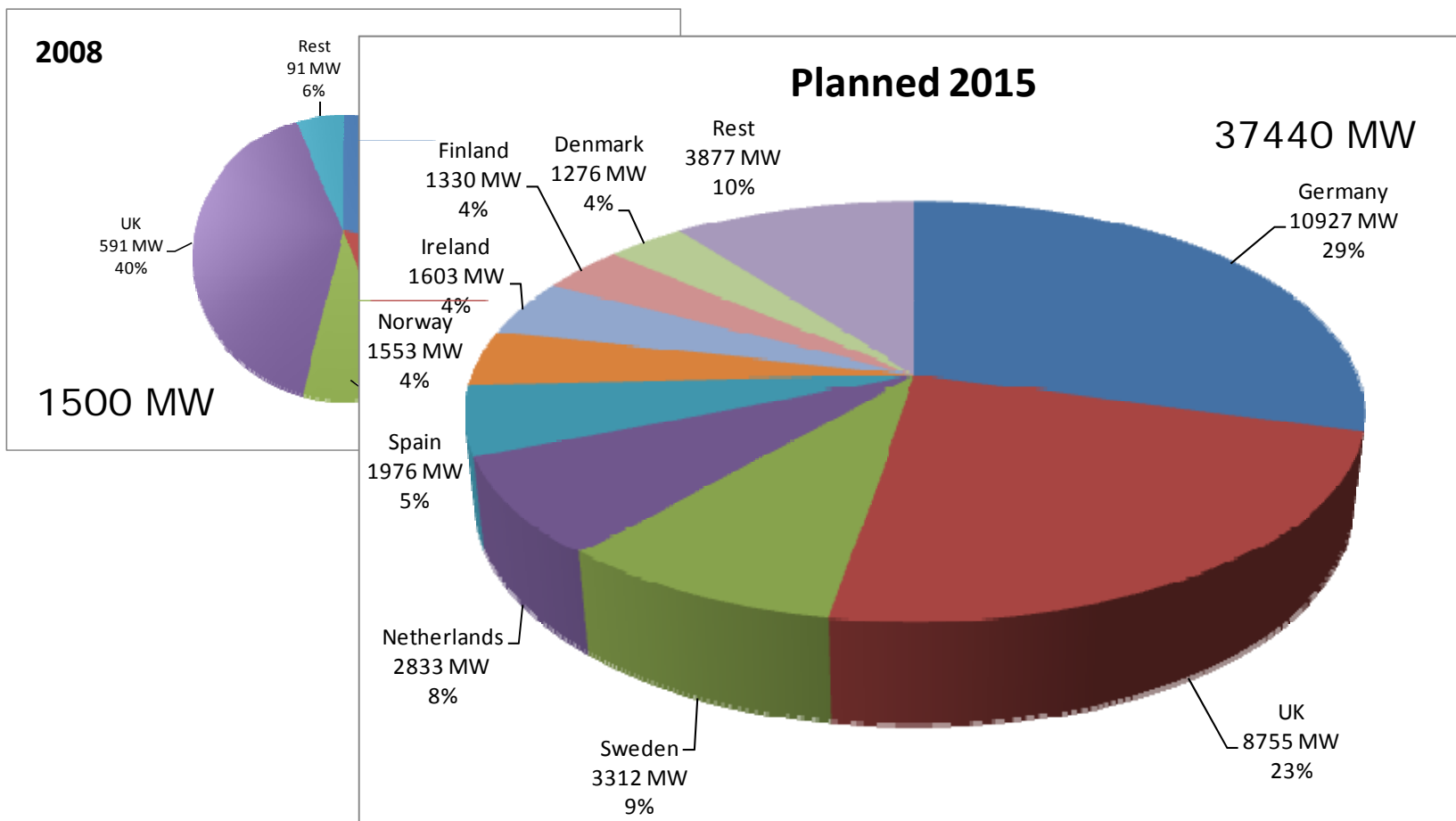
14.September 2009

$$f(x+\Delta x)=\sum_{i=0}^{\infty}\frac{(\Delta x)^i}{i!}f^{(i)}(x)$$

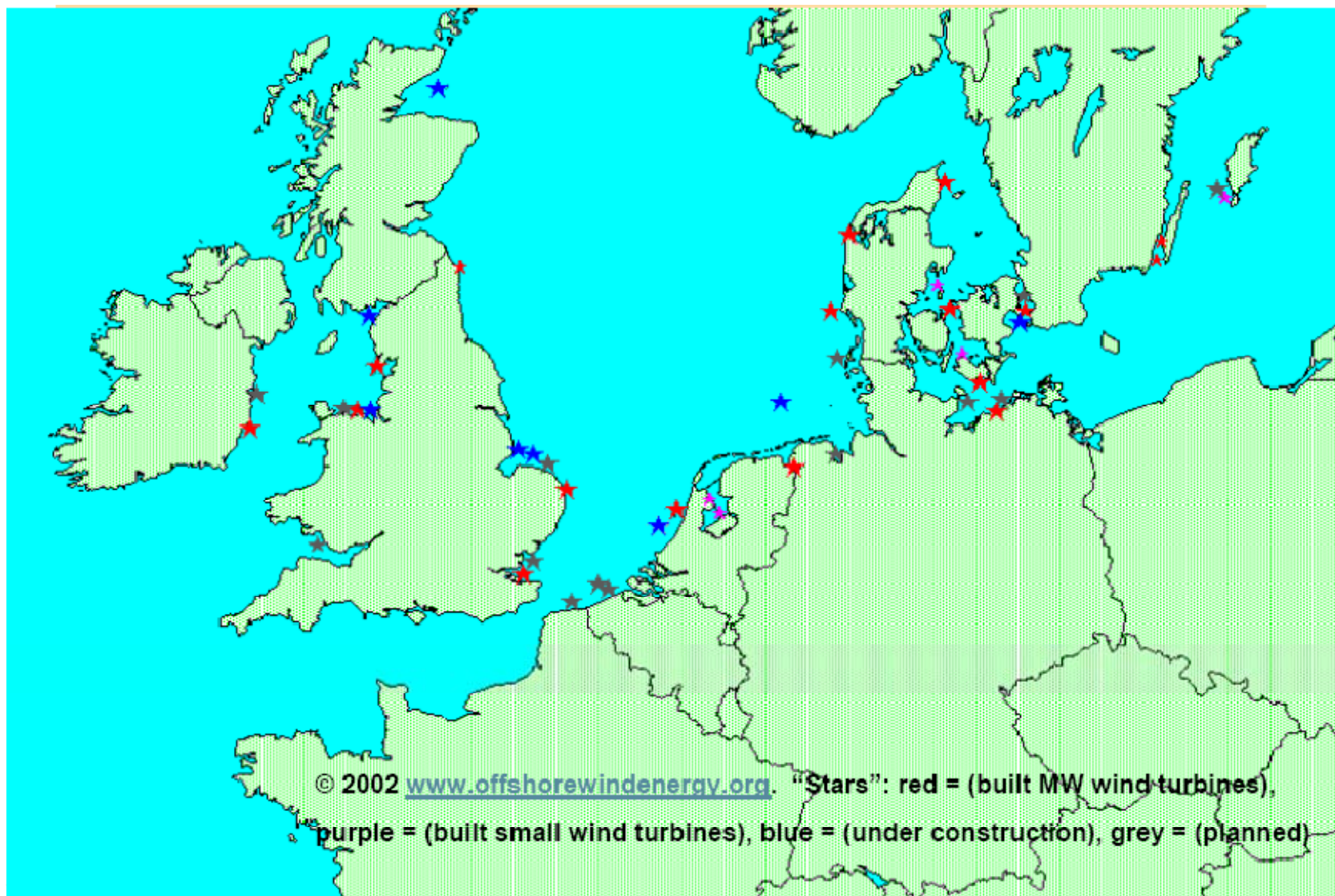
# Offshore Wind Power Development



# Offshore Wind Power Development

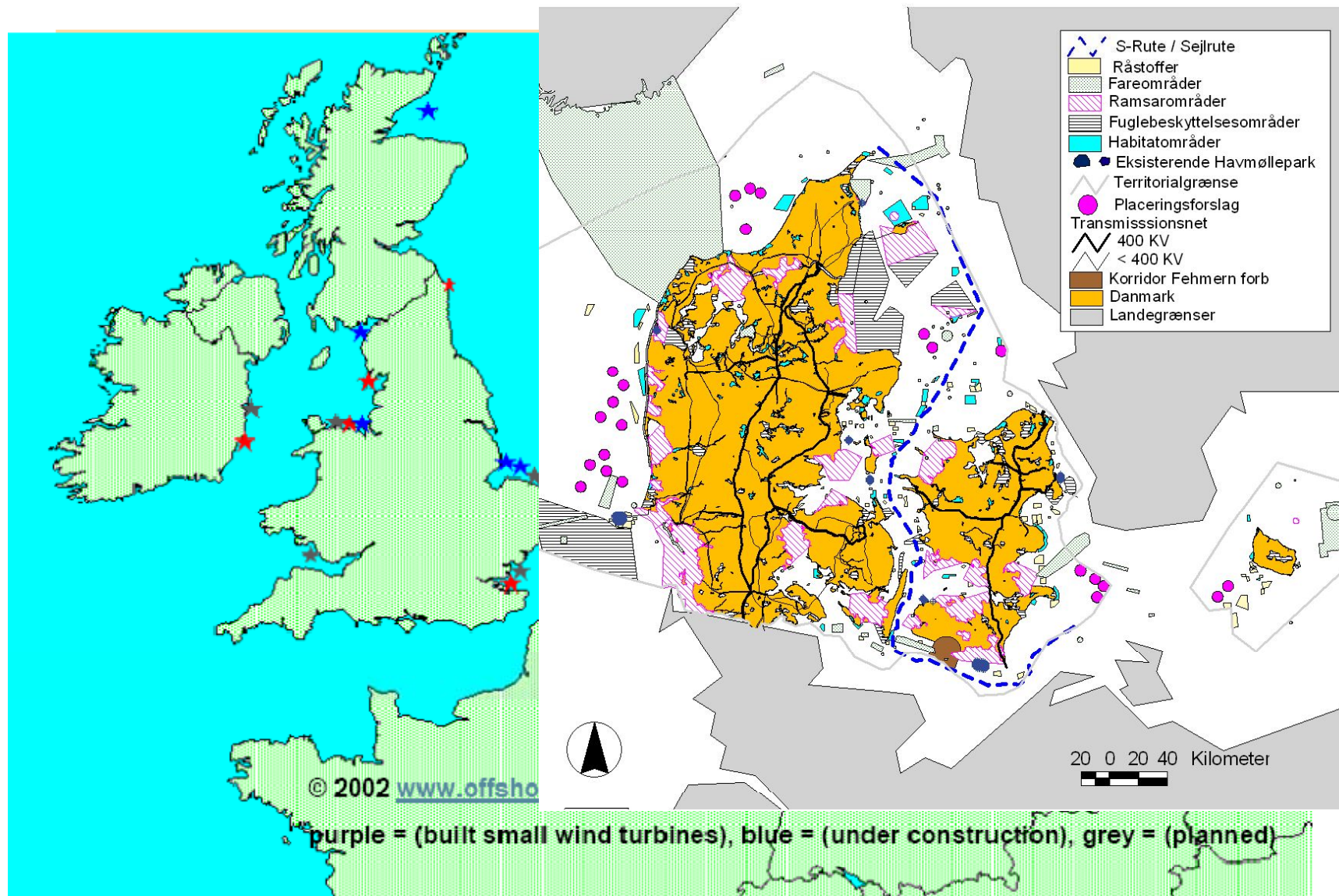


# Offshore Wind Farms – Built and Planned

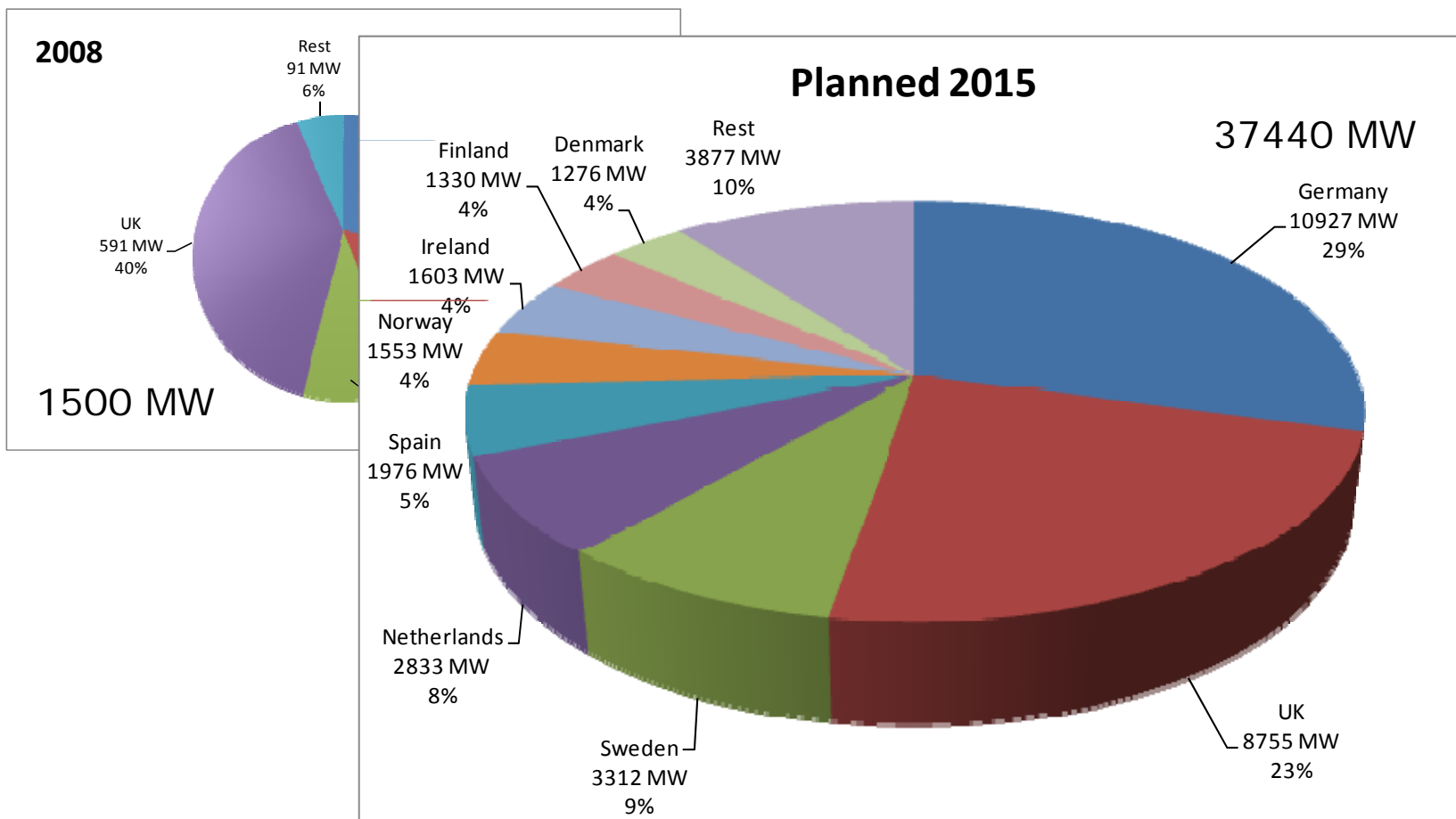




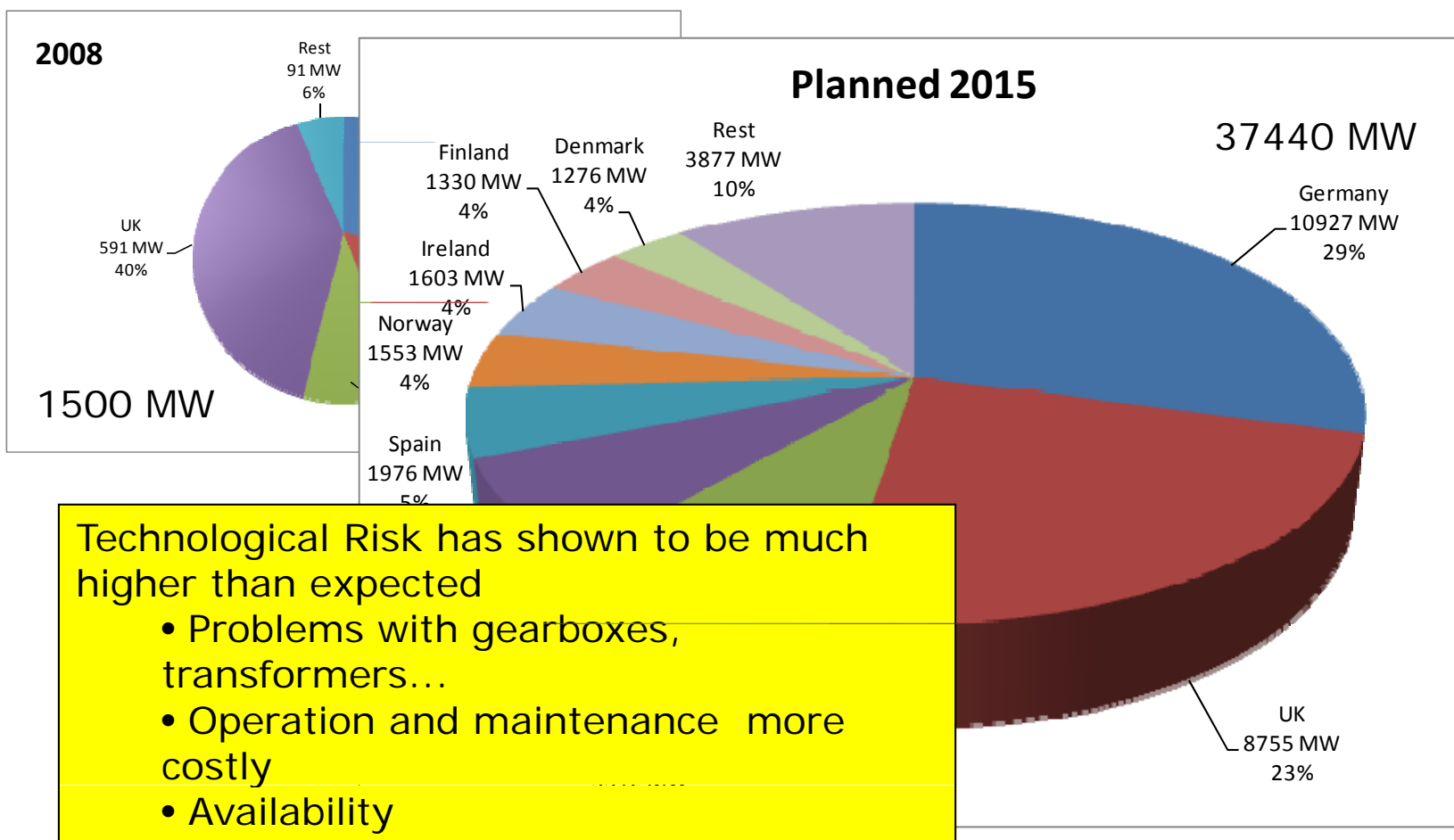
# Offshore Wind Farms – Built and Planned



# Offshore Wind Power Development



# Offshore Wind Power Development





# Risk and Uncertainty

- **Technological Risk**

- Investment Costs
- Maintenance Costs
- Production
- Availability
- Lifetime

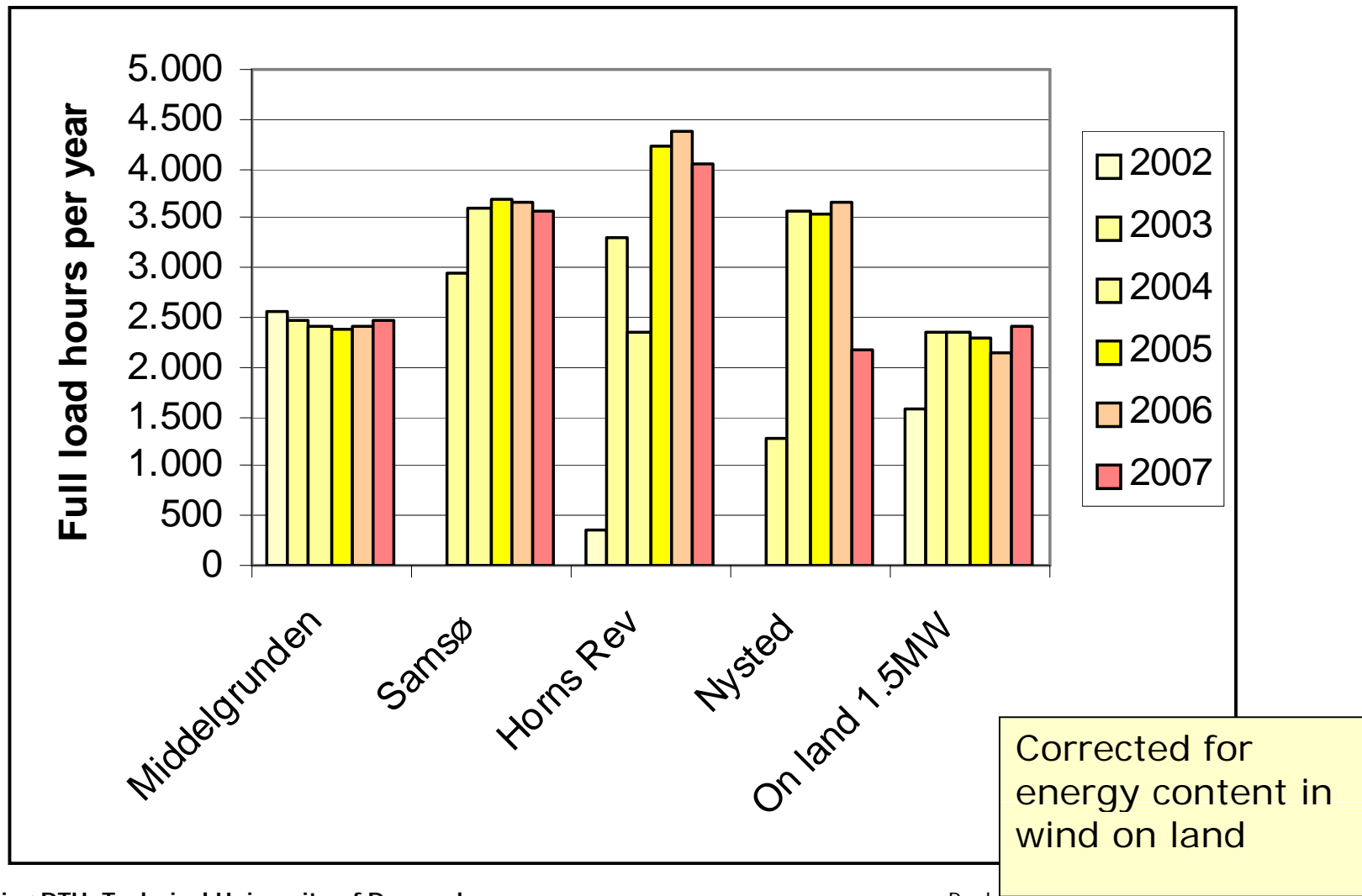
- **Regulatory Risk**

- Support Levels
- Market design

- **Market Risk**

- Power price
- Competition
- Fuel prices
- ....

# Experiences until now with Offshore wind power production



# Risk and Uncertainty

- **Technological Risk**

- Investment Costs
- Maintenance Costs
- Production
- Availability
- Lifetime

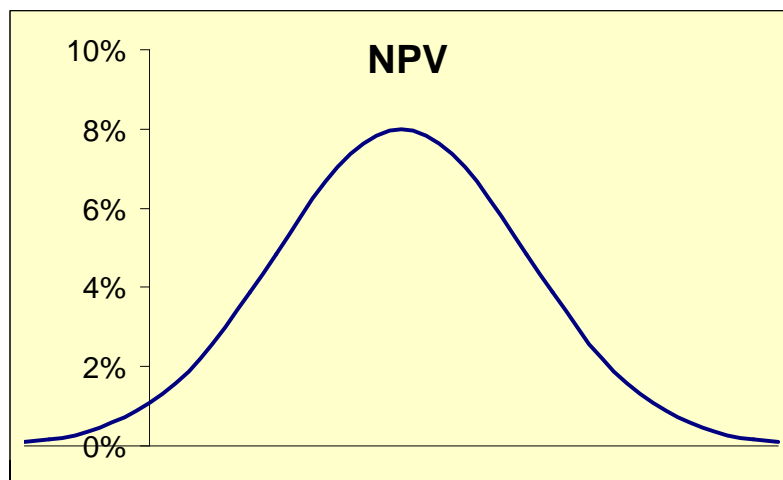
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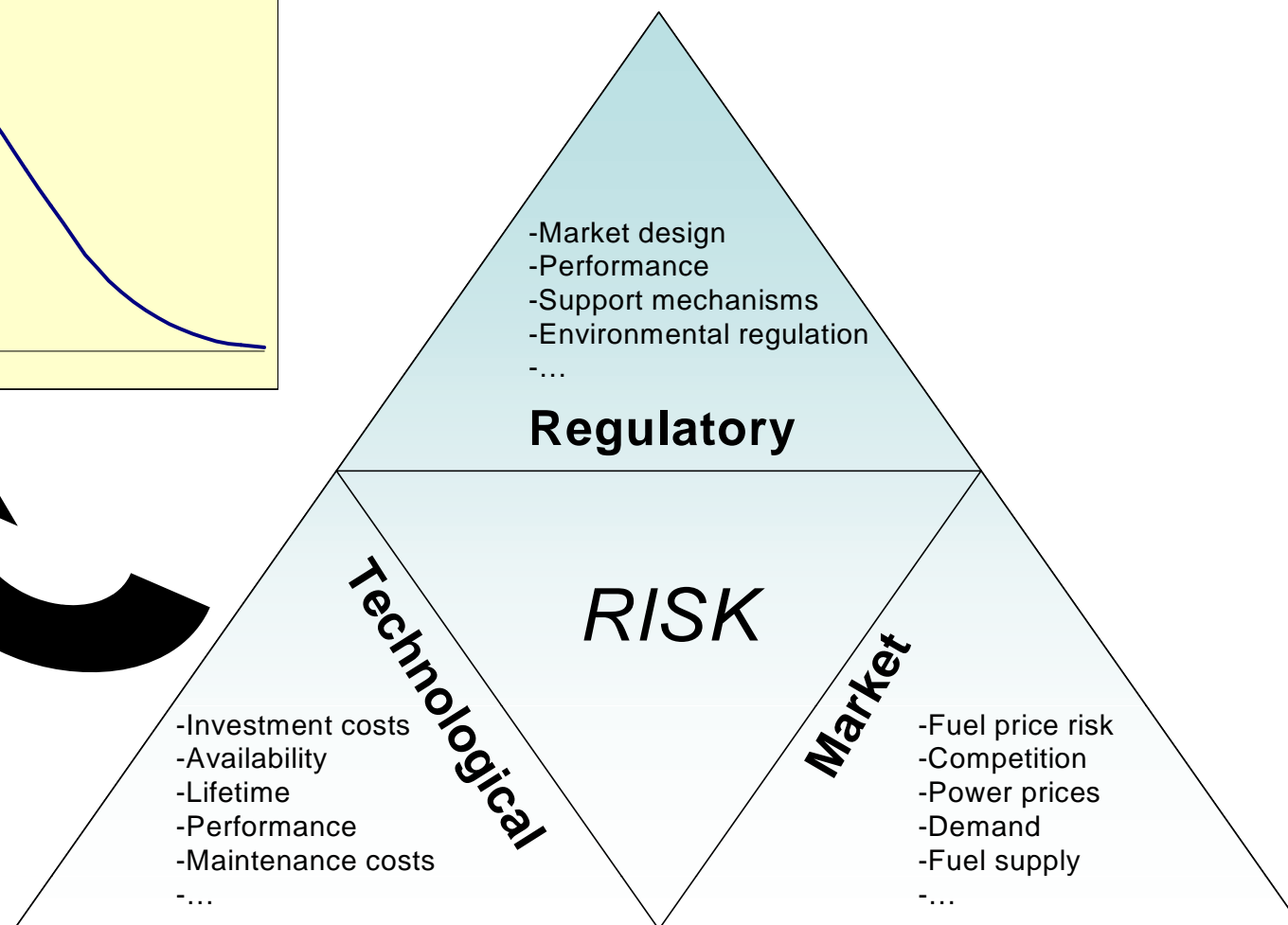
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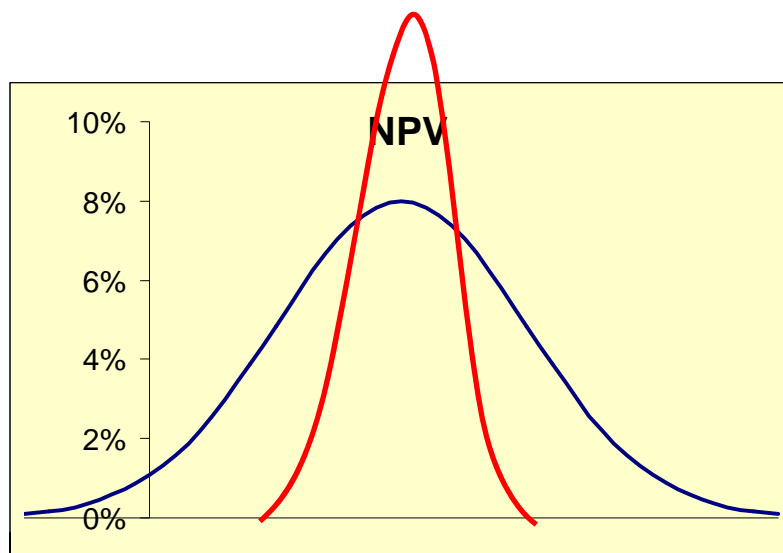
# Risk and Uncertainty



Uncertainty in Return  
of Investment



# Risk and Uncertainty



Ex ante  
optimisation

-Market design  
-Performance  
-Support mechanisms  
-Environmental regulation  
-...

**Regulatory**

**RISK**

**Technological**

-Investment costs  
-Availability  
-Lifetime  
-Performance  
-Maintenance costs  
-...

**Market**

-Fuel price risk  
-Competition  
-Power prices  
-Demand  
-Fuel supply  
-...

Uncertainty in Return  
of Investment

# Ex ante optimisation

- **Technological Risk**

- Investment Costs
- Maintenance Costs
- Production
- Availability
- Lifetime

- **Regulatory Risk**

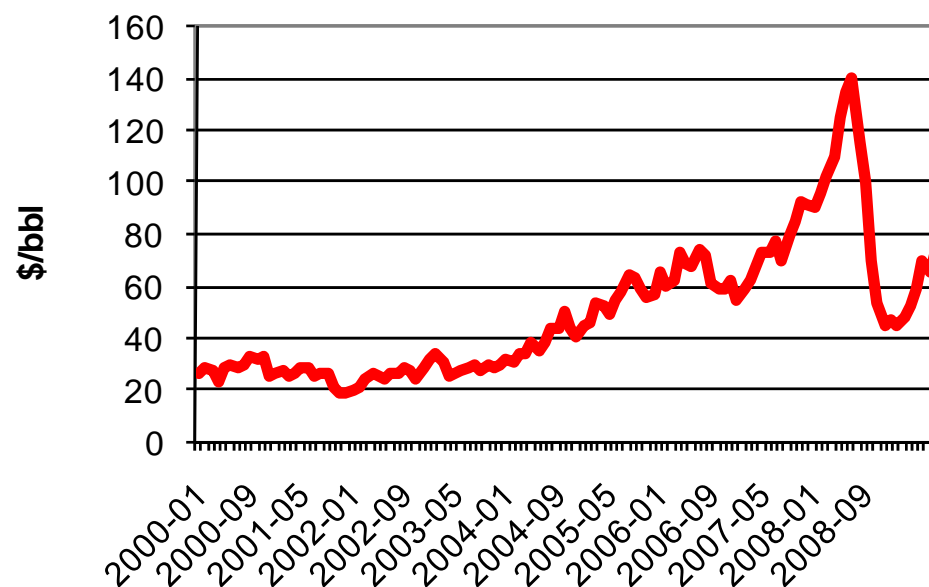
- Support Levels
- Market design

- **Market Risk**

- Power price
- Competition
- Fuel prices
- ....

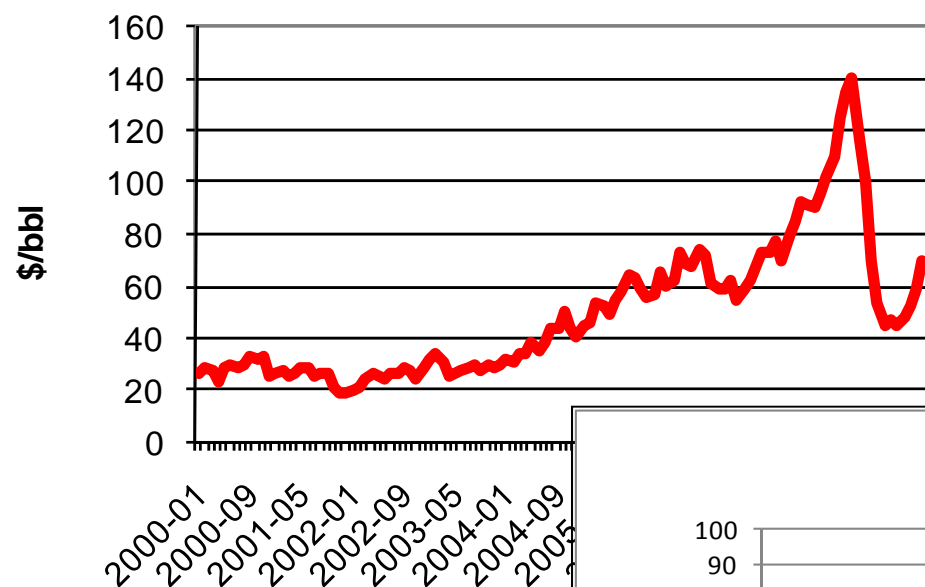


## Oilprice

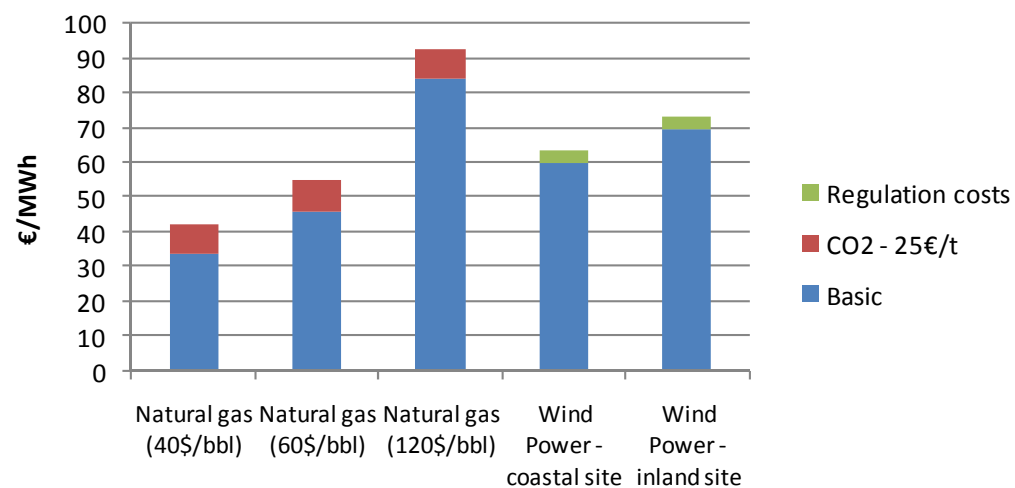


- Market design
- **Market Risk**
  - Power price
  - Competition
  - Fuel prices
  - ....

## Oilprice



- Market
- Market
- Power
- Compe
- Fuel p
- ....



# Ex ante optimisation

- **Technological Risk**

- Investment Costs
- Maintenance Costs
- Production
- Availability
- Lifetime

- **Regulatory Risk**

- Support Levels
- Market design

- **Market Risk**

- Power price
- Competition
- Fuel prices
- ....

# Ex-post optimisation

- **Technological Risk**

- Investment Costs
- Maintenance Costs
- Production
- Availability
- Lifetime

- **Regulatory Risk**

- Support Levels
- Market design

- **Market Risk**

- Power price
- Competition
- Fuel prices
- ....

## Ex post

**When the turbine is established the sum of Risks is (almost) constant**

- But we can pay somebody else to bear the risk for us**
  - We can hedge the power price*
  - We can agree on a prepaid service contract*
  - We can buy a production warranty*
- ... and, of course, some companies are more suited than others for taking risks**

## Comparison of two support systems:

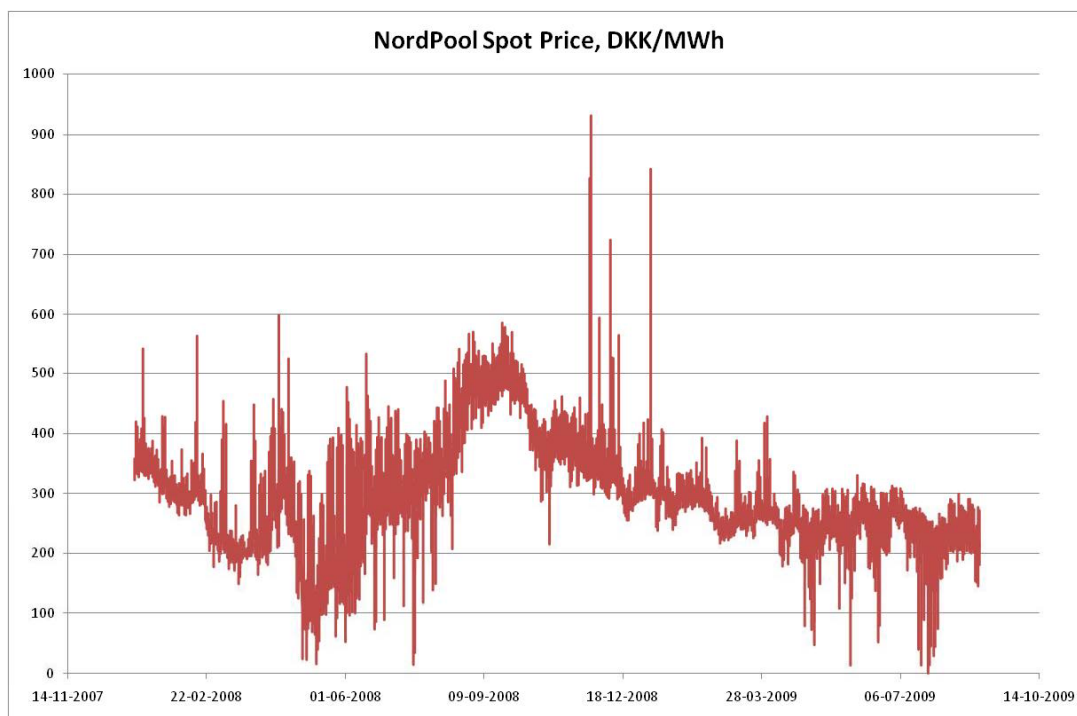


- A premium system and a fixed feed-in system
- Two actors: The private investor and the state

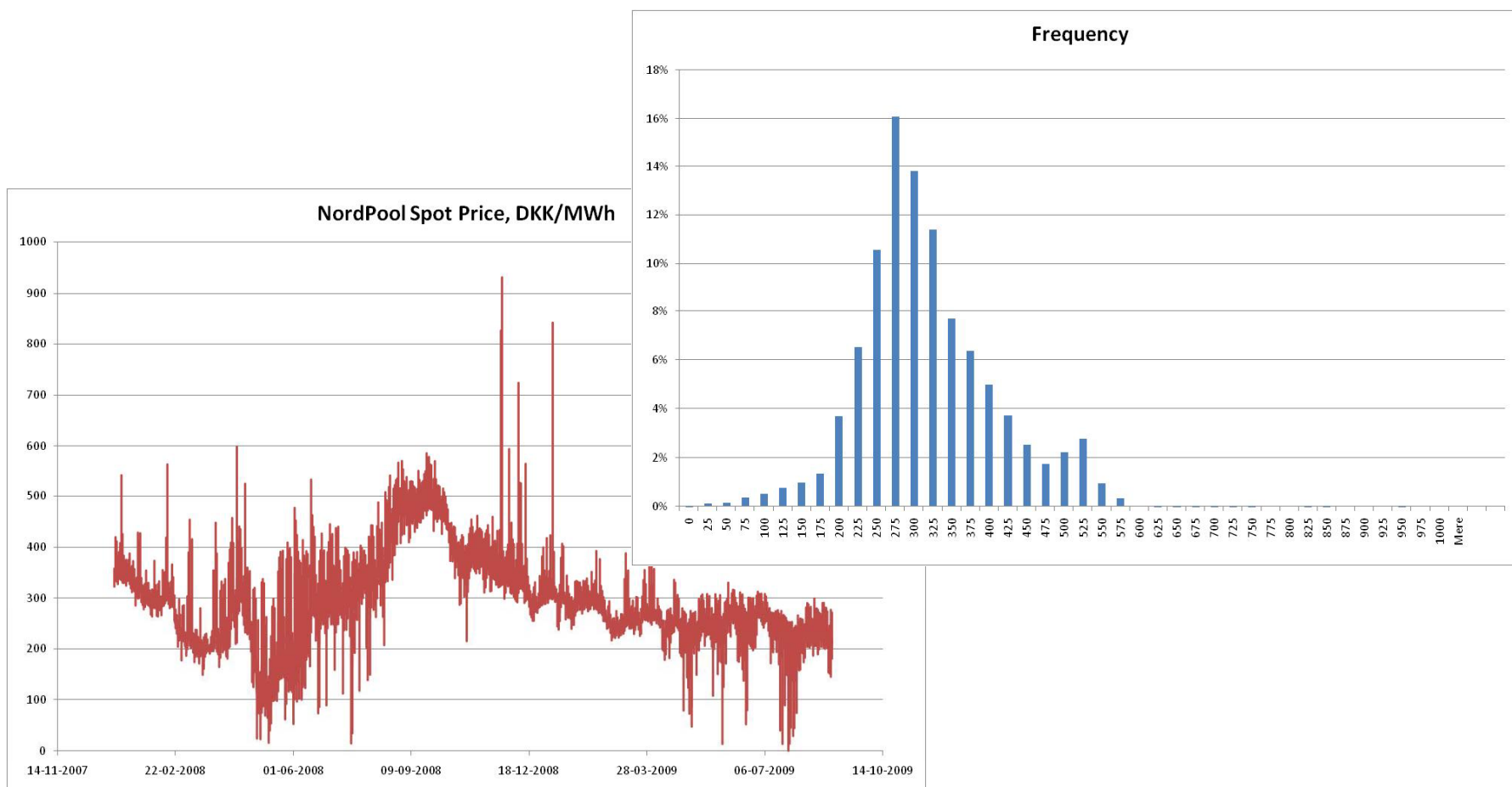
• Power price (average):	50 €/MWh
• Power price (std.):	5 €/MWh (10 %)
• Premium:	34 €/MWh
• Fixed feed-in:	84 €/MWh
• Duration:	44,000 Full Load Hours
• Discount rate:	6 %
• Production:	4000 h/MW/year



# Development of Power Price



# Development of Power Price

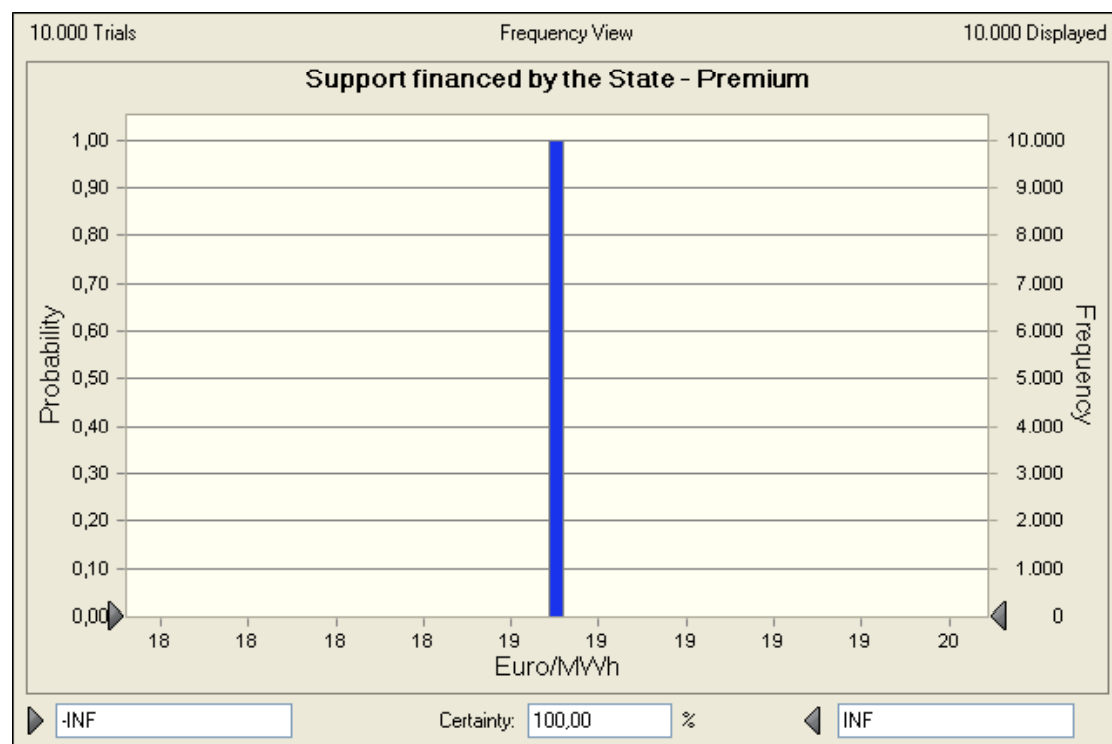


## Comparison of two support systems:

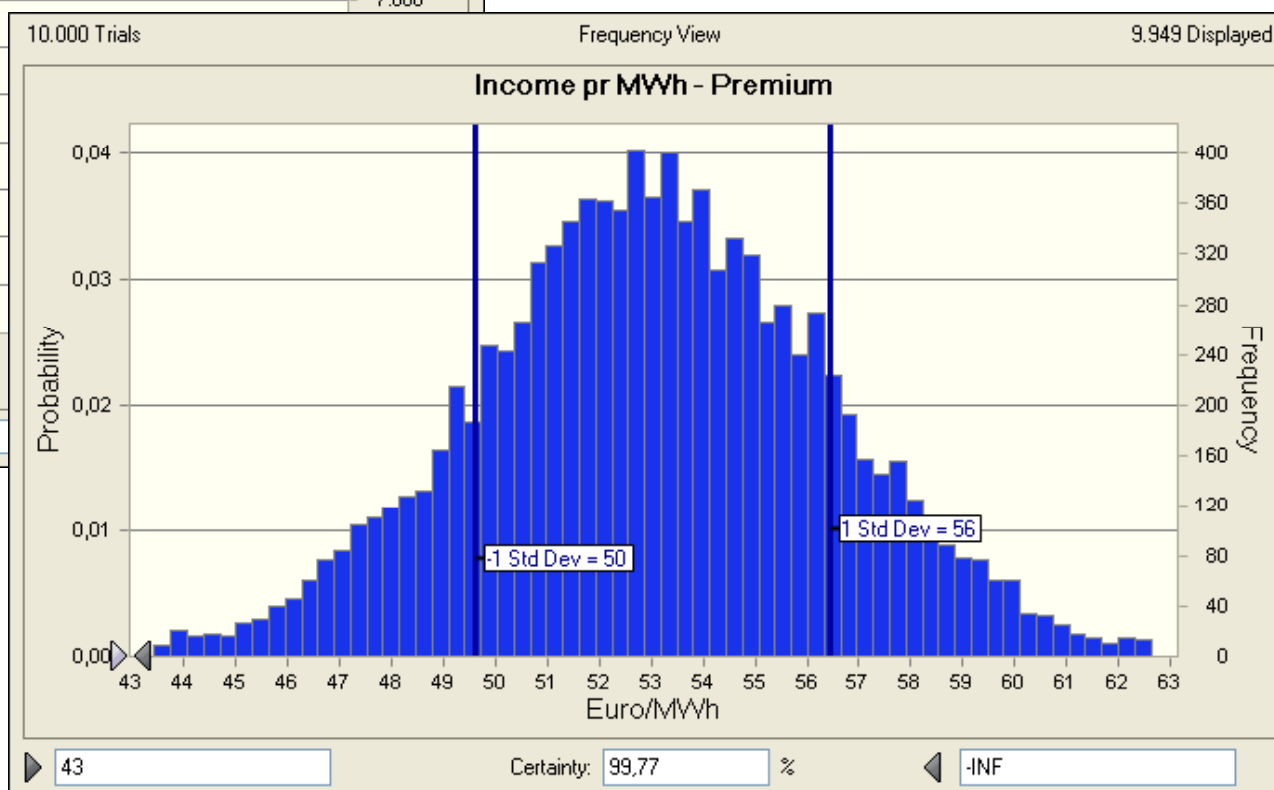
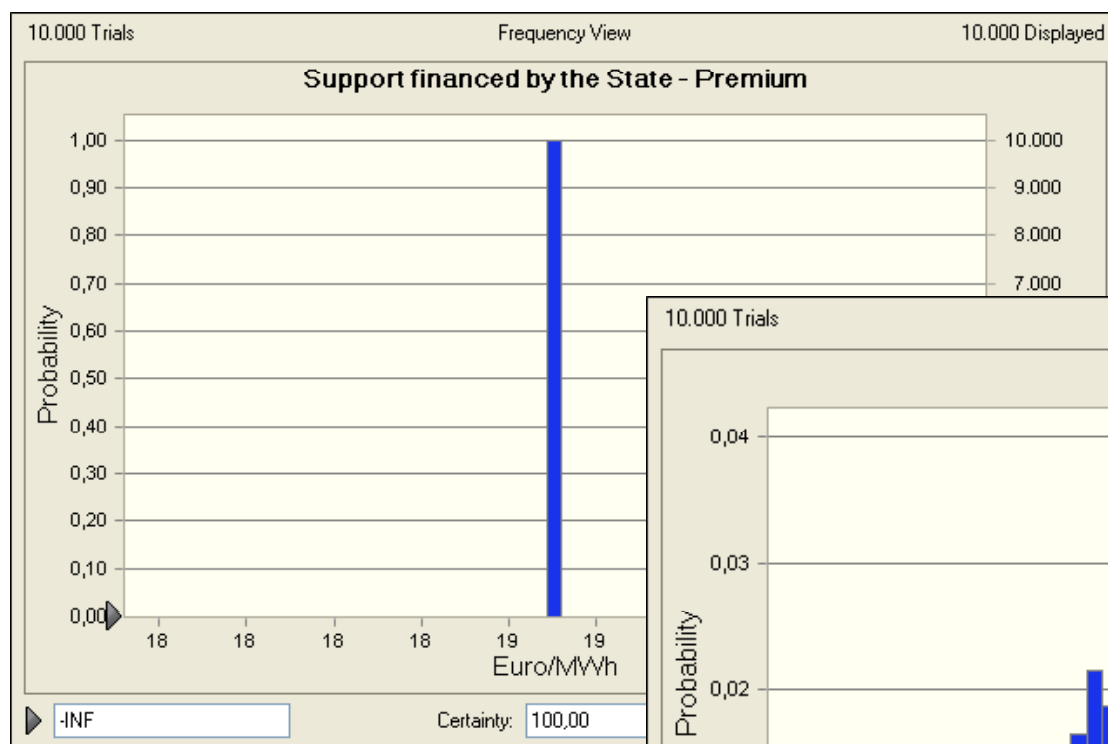
- A premium system
- A fixed feed-in system

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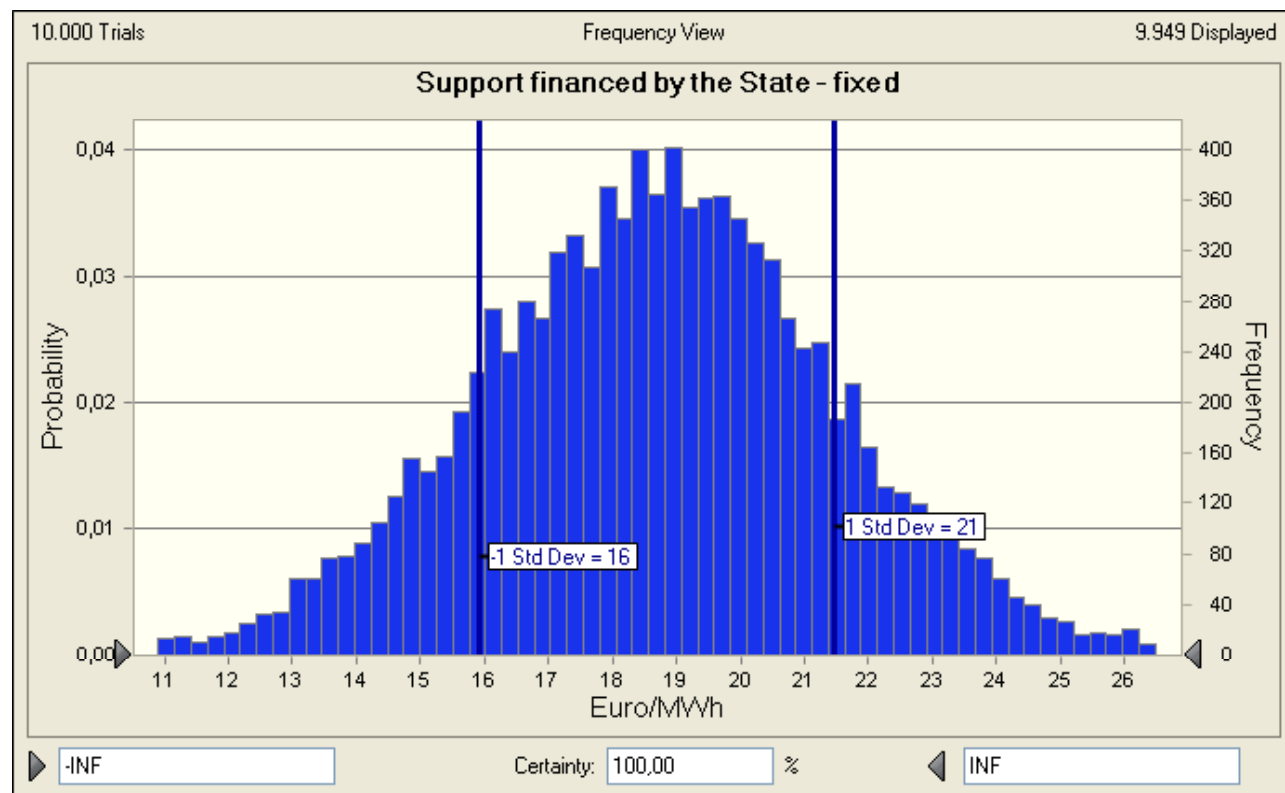
# Premium Feed-in



# Premium Feed-in

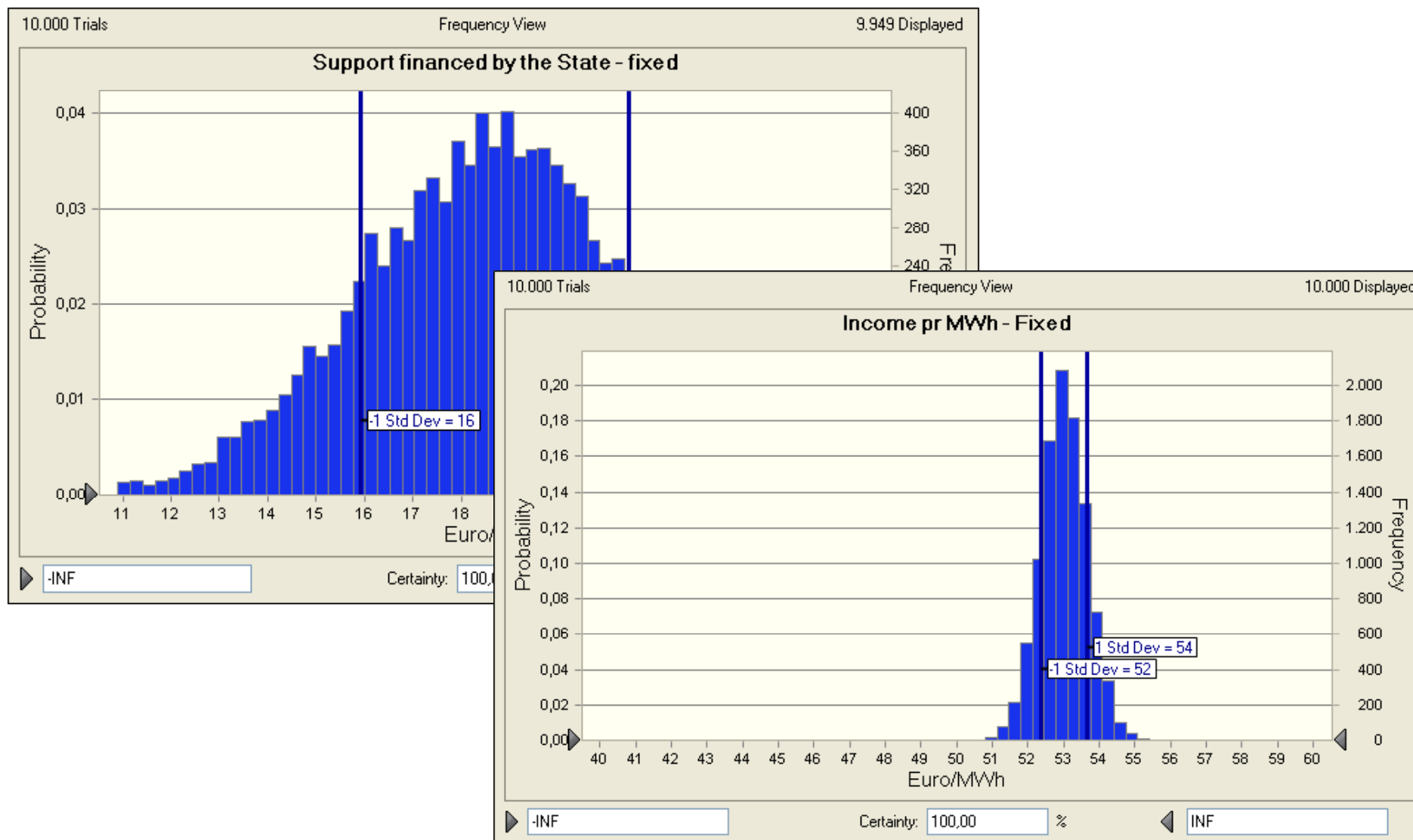


# Fixed Feed-in





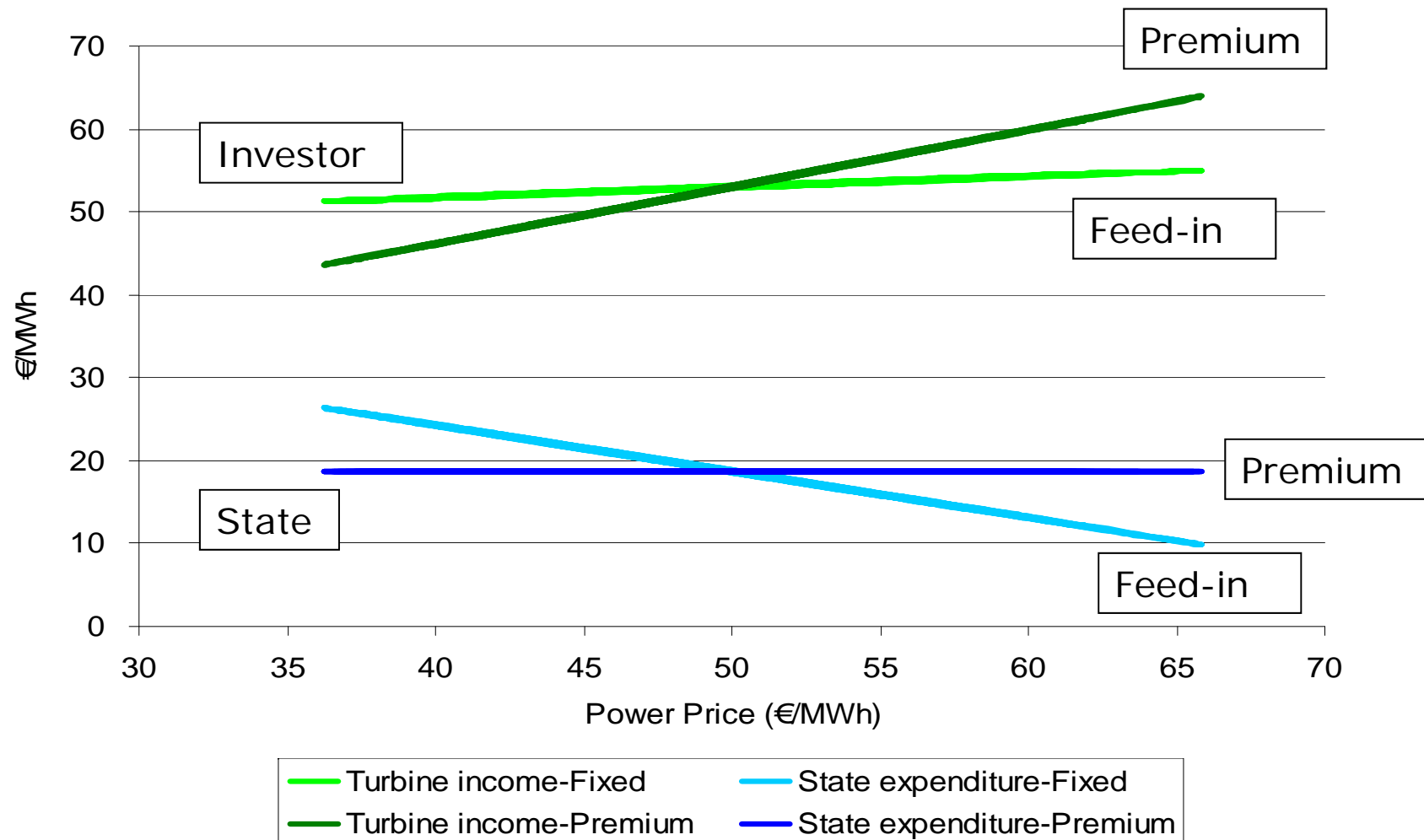
# Fixed Feed-in



## Risk for the State and the turbine owner

		<i>State</i>	<i>Turbine</i>
<i>Support</i>	<i>Premium</i>	0	3.42
	<i>Fixed</i>	2.78	0.64

# Correlation between Price and Support



## Conclusions

- **After the turbine is established the sum of risks is constant**
  - *But some companies/organisations might be better suited to bear the risk*
- **A premium system might for the private investor have a five-fold higher risk than a feed-in system**
  - *The state bears a high risk in the feed-in scheme*
- **If the state bears part of the risk this might imply a lower risk premium for society at large**